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Welfare Implications of Wheat Breeding Programs

Lia Nogueira
University of Nebraska-Lincoln, lia.nogueira@unl.edu

Cory Walters
University of Nebraska-Lincoln, cwalters7@unl.edu

Cornhusker Economics

University of Nebraska–Lincoln Extension

University of Nebraska Lincoln

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Institute of Agriculture & Natural Resources
Department of Agricultural Economics
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Market Report	Year Ago	4 Wks Ago	3/20/15
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	152.50	158.18	163.11
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	221.82	280.88	277.73
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	179.37	214.14	218.88
Choice Boxed Beef, 600-750 lb. Carcass.	242.41	239.47	246.04
Western Corn Belt Base Hog Price Carcass, Negotiated.	125.62	59.14	57.61
Pork Carcass Cutout, 185 lb. Carcass 51-52% Lean.	129.14	71.63	67.78
Slaughter Lambs, wooled and shorn, 135-165 lb. National.	155.00	198.75	145.67
National Carcass Lamb Cutout FOB.	371.16	361.05	367.44
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	7.22	4.83	5.19
Corn, No. 2, Yellow Nebraska City, bu.	4.39	3.67	3.69
Soybeans, No. 1, Yellow Nebraska City, bu.	13.84	9.64	9.29
Grain Sorghum, No.2, Yellow Dorchester, cwt.	7.89	7.14	7.41
Oats, No. 2, Heavy Minneapolis, Mn, bu.	4.47	3.08	3.14
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	182.50	*	200.00
Alfalfa, Large Rounds, Good Platte Valley, ton.	127.50	75.00	77.50
Grass Hay, Large Rounds, Good Nebraska, ton.	107.50	92.50	105.00
Dried Distillers Grains, 10% Moisture Nebraska Average.	235.00	177.50	172.50
Wet Distillers Grains, 65-70% Moisture Nebraska Average.	95.75	58.50	55.50

*** No Market**

Wheat is an important commodity for the United States and the state of Nebraska, both at the domestic and international levels. Land Grant Universities, such as University of Nebraska-Lincoln (UNL), invest in research to improve wheat characteristics that will benefit both producers and consumers. Funds available for agricultural research are a scarce resource that need to be justified. Measuring the welfare (well-being of individuals) effects of the UNL wheat breeding programs represent an important part of understanding the value of these programs. While this article does not directly address the impact of UNL wheat breeding program, it does highlight the importance of wheat breeding research at Washington State University (WSU). As a follow up to this study, our objective is to identify UNL's wheat breeding program's welfare contribution.

In 2014, Nebraska grew over 71 million bushels of wheat on 1.45 million acres, resulting in over $400 million in value (USDA-NASS). Nebraska's share of world wheat, however, is not large enough to affect world wheat prices. Hard red wheat is primarily grown in Nebraska because of favorable growing conditions. Wheat varieties in Nebraska are always being adapted to counteract disease and pest issues that affect producers' yield, such as fungi and insects, as well as to meet producer demand for higher-yielding varieties. Wheat varieties developed at UNL are being utilized in surrounding states, especially South Dakota.

Wheat breeding programs are important to producers and consumers. In addition to helping producers by increasing yield and/or quality, new varieties should also maintain or improve consumer-desired characteristics such as milling properties and the charac-

teristics required for good-quality bread, cakes, cookies, or pasta, depending on the specific wheat class. It is not always easy to justify increased expenditure in wheat breeding research. One reason is the long period of time from the beginning of the trials to the adoption of these varieties by growers[1]. Another reason is the fact that growers do not buy seed every year but save some of the harvested grain to plant the following year or years (Heisey, Lantican, and Dubin, 2002). The Department of Agronomy and Horticulture at UNL has several plant breeding programs, one of which is wheat. The wheat research program at UNL is funded by a mix of state and federal funds, as well as contributions from the Nebraska Wheat Board, fees, royalties, and endowments.

Wheat is not a homogeneous product. The agronomic characteristics of the different varieties and consumer preferences determine the end use of wheat, making the different wheat classes differentiated products. For example, flour made from hard wheat is mainly used for bread, soft wheat flour is mainly used for cakes and cookies, and durum wheat flour is mainly used for pasta. The United States produces five major wheat classes: hard red winter (HRW), hard red spring (HRS), soft red winter (SRW), soft white winter (SWW), and durum wheat (DUR). Production of the different classes of wheat in the United States is highly segregated. HRW is grown mainly in Kansas, Nebraska and Oklahoma (central plains), HRS and DUR are grown mainly in North Dakota (northern plains), SRW is produced in the Corn Belt and Southern states, and SWW is grown in the Pacific Northwest, Michigan, and New York (Koo and Taylor, 2006).

Given the limited substitutability for milling purposes among these wheat classes (Marsh, 2005; Mulik and Koo, 2006), it is important to analyze these different classes when studying wheat for the United States. We specifically model each wheat class independently and then subdivide the classes corresponding to varieties developed at WSU into seven different regions. For Washington, Oregon, and Idaho, we subdivide each state into varieties developed by WSU and others, and the rest of the United States is comprised by the other regions. We divide consumption for each class between domestic consumption and exports.

The main objective of this study is to calculate the welfare effects of the WSU wheat breeding programs for producers and consumers (wheat buyers) in Washington, Oregon, Idaho, and the United States, and for importers of U.S. wheat. We extend previous work to develop a detailed multiregion, multiproduct, and multivariety model that includes spillover effects and accounts for the limited substitution among wheat classes. We use the approach by Michalski (2012) to estimate the yield improvement by wheat class because of the WSU breeding programs. Our framework and results will be useful to decision makers in the government because we evaluate expenditures on the WSU wheat breeding programs by calculating the welfare effects of these programs and comparing them with the associated costs.

We follow Alston, Norton, and Pardey (1995) in the development of our theoretical equilibrium displacement model. We include production of each wheat class in the United States and consumption of each U.S. wheat class in the United States and the rest of the world (exports) to get a multiproduct model. Furthermore, we subdivide the wheat classes for which WSU wheat breeding programs have developed varieties (HRW, HRS, and SWW) into Washington, Oregon, Idaho, and Other States to obtain a multiregion model, in which each state studied is further divided into production of WSU varieties and Other (WAWSU, WA-Other, OR-WSU, OR-Other, ID-WSU, and ID-Other). In this way, we allow for spillover effects to Idaho and Oregon. We also incorporate cross-commodity price effects to allow for limited substitution in demand among wheat classes. Because we are only interested in simulating the welfare effects of yield improvements in WSU-developed varieties, we hold all other yield improvements constant, including improvements because of technology, management practices, and other wheat breeding programs[2].

Our results provide evidence suggesting that WSU wheat breeding programs have increased welfare for the state of Washington, the United States, and importers of U.S. wheat. Overall, consumers in all regions and producers using WSU-developed varieties have increased surplus from yield increases in wheat because of WSU wheat breeding programs, attributable to the combination of lower prices and higher yields of WSU varieties over parts of the study period. However, producers using non-WSU varieties and producers of other wheat classes have in general decreased surplus because of lower prices and constant yields. It is important to note that this model is partial

[1] It can take from 7 to 12 years to develop and market a new wheat variety

[2] It should be noted that other states could be using wheat varieties with similar yield improvements, and thus, spillover effects may wash out once other yield improvements are considered.

equilibrium, and thus, we are holding constant all other potential yield increases by technology or other wheat breeding programs to concentrate on the effect of WSU wheat breeding programs. Changes in total surplus are positive for all regions. Nevertheless, the surplus changes in Idaho and Oregon are much smaller relative to the increases in Washington, and the net effects for the United States are positive.

We have analyzed the important question of whether funds allocated to the WSU wheat breeding programs had a reasonable return. We compare the expenditures in the WSU wheat breeding programs with the benefits calculated with our model, and we find that for each dollar spent there is $1.75 in benefits, considering a 10-year lag to release a new variety. The net present value of the program from 1993 to 2020 is $9.13 million (2011 dollars), and the internal rate of return is 17.75%. Our results are important for WSU and policy makers in general because they provide justification for the current funds allocated to the wheat breeding programs.

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Lia Nogueira
Assistant Professor
Agricultural Economics Department
University of Nebraska-Lincoln
Lia.nogueira@unl.edu

Cory Walters
Assistant Professor
Agricultural Economics Department
University of Nebraska-Lincoln
cwalters7@unl.edu

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